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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/781,353	02/17/2004	Jennifer Wang	P1571	9226
7590 LaRiviere, Grubman & Payne, LLP P.O. Box 3140 Monterey, CA 93942			EXAMINER	
			MAI, ANH D	
ART UNIT		PAPER NUMBER		
2814				
MAIL DATE		DELIVERY MODE		
10/07/2008		PAPER		

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**BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES**

Application Number: 10/781,353

Filing Date: February 17, 2004

Appellant(s): WANG ET AL.

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Theresa J. Wasilausky  
Reg. No. 53,746  
For Appellant

**EXAMINER'S ANSWER**

This is in response to the appeal brief filed June 20, 2008 appealing from the Office action mailed September 5, 2007.

**(1) Real Party in Interest**

A statement identifying by name the real party in interest is contained in the brief.

**(2) Related Appeals and Interferences**

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

**(3) Status of Claims**

The statement of the status of claims contained in the brief is correct.

**(4) Status of Amendments After Final**

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

**(5) Summary of Claimed Subject Matter**

The summary of claimed subject matter contained in the brief is correct.

**(6) Grounds of Rejection to be Reviewed on Appeal**

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

**(7) Claims Appendix**

The copy of the appealed claims contained in the Appendix to the brief is correct.

**(8) Evidence Relied Upon**

US Patent No. 6,515,369	Lin	2-2003
US Patent No. 6,004,883	Yu et al.	12-1999
US Pub. No. 2002/0068441	Lin	6-2002

**(9) Grounds of Rejection**

The following ground(s) of rejection are applicable to the appealed claims:

***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

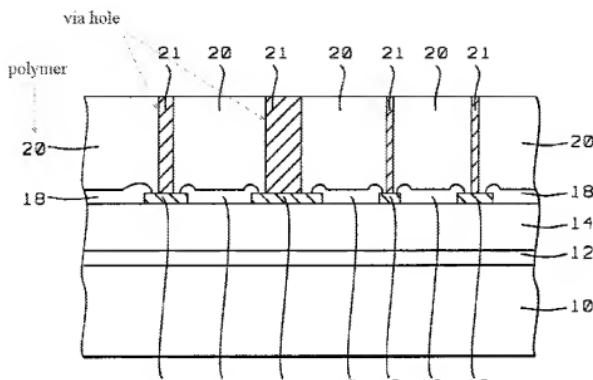
1. Claims 21, 22 and 25 are rejected under 35 U.S.C. 102(b) as being anticipated by Lin (U.S. Patent No. 6,515,369) of record.

With respect to claim 21, insofar as the device is concerned, Lin teaches a device including a via as claimed including:

a polymer layer (20);

a via hole (22) with at least one vertical sidewall,

whereby the via hole comprises an aspect ration which is greater than 1, and is of substantially the same diameter throughout the depth of the via hole. (See Figs. 5a).



*FIG. 5a*

With respect to claim 22, insofar as the device is concerned and in light of the Applicant's Remarks in the Pre-Appeal Brief Request for Review, Lin teaches a device including a via as claimed including:

a polymer layer (20) having a sub-micron wide via-opening (22) formed on a semiconductor substrate (10);

whereby the via hole (22) comprises an aspect ratio which is greater than 1, and is of substantially the same diameter through out at least one-half the depth of the via hole and at least one tapered sidewall within the via hole. (See at least Fig. 10).

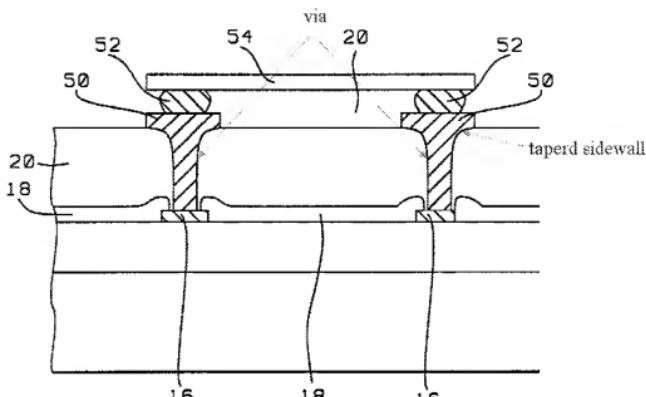


FIG. 10

With respect to claim 25, Insofar as the device is concerned, Lin teaches a device as claimed including:

a polymer layer (20);

a via hole (22) having sub-micron wide formed in the polymer layer (20), the via hole having at least one vertical sidewall;

whereby the via hole comprises an aspect ratio which is greater than 1, and is of substantially the same diameter through out at least one-half the depth of the via hole; and at least one tapered sidewall within the via hole. (See Fig. 10).

Product by process limitation: (applies to all claims)

The expression "a via produced by the process comprising the steps of" and "placing a hard-mask on a polymer layer; placing a photoresist mask on said hard-mask; releasing a first

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*fluoride gas into a chamber to etch a hard-mask opening for defining a via hole; releasing a second fluoride gas into said chamber to etch an exposed portion of said polymer layer defining said via hole with vertical sidewalls; releasing a third fluoride gas into said chamber to etch an exposed portion of said polymer layer defining said via hole with at least one tapered sidewall*" is/are taken to be a product by process limitation and are given no patentable weight. A product by process claim directed to the product per se, no matter how actually made, *In re Hirao*, 190 USPQ 15 at 17 (footnote 3). See *In re Fessman*, 180 USPQ 324, 326 (CCPA 1974); *In re Marosi et al.*, 218 USPQ 289, 292 (Fed. Cir. 1983); *In re Brown*, 459 F.2d 531, 535, 173 USPQ 685, 688 (CCPA 1972); *In re Pilkington*, 411 F.2d 1345, 1348, 162 USPQ 145, 147 (CCPA 1969); *Buono v. Yankee Maid Dress Corp.*, 77 F.2d 274, 279, 26 USPQ 57, 61 (2d. Cir. 1935); and particularly *In re Thorpe*, 227 USPQ 964, 966 (Fed. Cir. 1985), all of which make it clear that it is the patentability of the final structure of the product "gleaned" from the process steps, which must be determined in a "product by process" claim, and not the patentability of the process. See also MPEP 2113. Moreover, an old and obvious product produced by a new method is not a patentable product, whether claimed in "product by process" claims or not.

**Note that Applicant has burden of proof in such cases** as the above case law makes clear.

#### *Claim Rejections - 35 USC § 103*

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claim 21 is further rejected under 35 U.S.C. 103(a) as being unpatentable over Yu et al. (U.S. Patent No. 6,004,883) in view of Lin (U.S. Pub. No. 2002/0068441) all of record, as previously applied.

With respect to claim 21, insofar as the device is concerned and as best understood by the examiner, Yu teaches a device including a via substantially as claimed including:

a hard mask (18) on a polymer layer (16);

a photoresist mask (20) on the hard mask (18)

at least one via hole (25) with vertical sidewall, defined in the polymer layer (16), and is of substantially the same diameter throughout the depth of the via hole (25). (See Figs. 2-3).

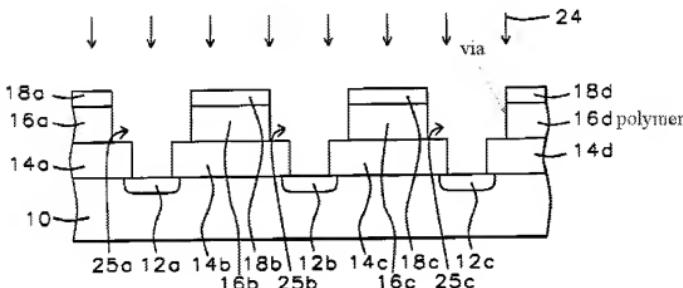


FIG. 3

Thus, Yu is shown to teach all the features of the claim with the exception of explicitly disclosing the aspect ratio of the via.

However, Lin teaches via (7) defined in a polymer layer (5) having an aspect ratio of greater than 1 are routinely used to for the contact in ULSI, and is of substantially the same diameter throughout the depth of the via hole.

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to define the via of Yu having an aspect ratio of greater than 1 in the polymer layer as taught by Lin to form contacts to a lower layer with smaller resistance and capacitance and is easier and more cost effective to manufacture.

Additionally, it would have been an obvious matter of design choice to define a via having aspect ratio greater than 1, since such a modification would have involve a mere change in the size of a component. A change in size is generally recognized as being within the level of ordinary skill in the art. *In re Rose*, 105 USPQ 237 (CCPA 1955).

Furthermore, the specification contains no disclosure of either the *critical nature of the claimed aspect ratio of greater than 1* of any unexpected results arising therefrom. Where patentability is aid to based upon particular chosen dimension or upon another variable recited in a claim, the Applicant must show that the chosen dimension are critical. *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Also, within purview of one having ordinary skill in the art, it would have been obvious to determine the optimum aspect ratio of the via. See *In re Aller, Lacey and Hall* (10 USPQ 233-237) “It is not inventive to discover optimum or workable ranges by routine experimentation”.

*Product by process limitation:*

The expression “a via produced by the process comprising the steps of” and “*placing*” and “*releasing a first fluoride gas into a chamber to etch a hard-mask opening for defining said via hole; and releasing a second fluoride gas into said chamber to etch an exposed portion of said polymer layer defining said via hole with vertical sidewalls*” is/are taken to be a product by process limitation and are given no patentable weight. A product by process claim directed to the product per se, no matter how actually made, *In re Hirao*, 190 USPQ 15 at 17 (footnote 3). See *In re Fessman*, 180 USPQ 324, 326 (CCPA 1974); *In re Marosi et al.*, 218 USPQ 289, 292 (Fed. Cir. 1983); *In re Brown*, 459 F.2d 531, 535, 173 USPQ 685, 688 (CCPA 1972); *In re Pilkington*, 411 F.2d 1345, 1348, 162 USPQ 145, 147 (CCPA 1969); *Buono v. Yankee Maid Dress Corp.*, 77 F.2d 274, 279, 26 USPQ 57, 61 (2d. Cir. 1935); and particularly *In re Thorpe*, 227 USPQ 964, 966 (Fed. Cir. 1985), all of which make it clear that it is the patentability of the final structure of the product “gleaned” from the process steps, which must be determined in a “product by process” claim, and not the patentability of the process. See also MPEP 2113. Moreover, an old

and obvious product produced by a new method is not a patentable product, whether claimed in "product by process" claims or not.

**Note that Applicant has burden of proof in such cases as the above case law makes clear.**

3. Claims 23, 24, 26 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lin '369.

Lin teaches the via hole as describe in claims 22 and 25 above including the via hole having aspect ratio which is greater than 1, and is of substantially the same diameter through out at least one-half the depth of the via hole and the via of Lin also includes a tapered sidewall within the via. (See Fig. 10).

Thus, Lin is shown to teach all the features of the claim with the exception of explicitly disclosing the tapered sidewall extending at least one-third or one-half of the depth.

Note that the specification contains no disclosure of either the *critical nature of the claimed extending of the tapered sidewall in the range from one-third to one-half* of any unexpected results arising therefrom. Where patentability is aid to based upon particular chosen dimension or upon another variable recited in a claim, the Applicant must show that the chosen dimension are critical. *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to form the tapered portion of the via of Lin so that contact to the lower pad can be made with smaller resistance and capacitance and is easier and more cost effective to manufacture.

Furthermore, within purview of one having ordinary skill in the art, it would have been obvious to determine the optimum depth of the taper sidewall. See *In re Aller, Lacey and Hall* (10 USPQ 233-237) “It is not inventive to discover optimum or workable ranges by routine experimentation”.

**(10) Response to Argument**

**(1) Claim objection:**

The objection to claim 22 has been withdrawn due to the amendment filed April 2, 2007.

**(2) The Rejection Under 35 U.S.C. 102 (b):**

**(a) Claim 21**

Appellant argues: Lin is silent on teaching how to achieve this complicated *process*. Appellant novel *process* results in a device that has never before been accomplished on a submicron level.

However, the limitation of the claim is “A device including a via **produced by the process**”.

As had been discussed throughout the prosecution, this Examiner has clear stated that it is the patentability of the final structure of the product “gleaned” from the process steps, which must be determined in a “product by process” claim, and *not the patentability of the process*. See also MPEP 2113. Moreover, an old and obvious product produced by a new method is not a patentable product, whether claimed in “product by process” claims or not. See *In re Fessman*, 180 USPQ 324, 326 (CCPA 1974); *In re Marosi et al.*, 218 USPQ 289, 292 (Fed. Cir. 1983); *In*

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*re Brown*, 459 F.2d 531, 535, 173 USPQ 685, 688 (CCPA 1972); *In re Pilkington*, 411 F.2d 1345, 1348, 162 USPQ 145, 147 (CCPA 1969); *Buono v. Yankee Maid Dress Corp.*, 77 F.2d 274, 279, 26 USPQ 57, 61 (2d. Cir. 1935); and particularly *In re Thorpe*, 227 USPQ 964, 966 (Fed. Cir. 1985).

As a device, the physical aspect of the claim includes: a via hole being formed in a polymer layer having an aspect ratio (defined as depth/width ratio) of which is greater than 1 and is of substantially the same diameter throughout the depth of the via hole. Other than “via hole comprises an aspect ratio which is greater than 1”, the actual size of the via hole, being submicron, etc., has never been recited in the claim.

Lin in figure 5a, clearly teaches such a device including a via formed in the polymer layer 20.

Therefore, the rejection of claim 21 should be maintained.

(b) Claim 22

Appellant argues:

Lin is silent as to the *tapering and verticality of the sidewalls* of such vias. The Examiner has cited Figure 10, however there is no disclosure that there is tapering of the sidewall, much less how to achieve it. Appellants invention is unobvious because it presents a novel way to etch vertical sidewalls in a via along with a tapered opening, **such that via openings are not overlapping and damaging adjacent features. This novel process results in a device that has never before been accomplished on a sub-micron or micron level.** Nowhere within Lin '369 does it teach the elements of Claim 22.

However, as shown in figure 10, Lin teaches a via (22, size from 0.5  $\mu\text{m}$  to 30  $\mu\text{m}$ , hence sub-micron or micron level) having tapered (top portion) and vertical sidewall (lower portion). Drawings and pictures can anticipate claim if the clearly show the structure which is claimed.

See *In re Mraz*, 455 F.2d 1069, 173 USPQ 25 (CCPA 1972).

Moreover, similar as claim 21 above, the Appellant also argues above the novel process. However, as discussed above, the claimed invention is “a device” not “a process”.

Therefore, the rejection of claim 22 should be maintained.

(c) Claim 25

Similar to claim 22 above, the Appellant repeats the same argument.

The same response to claim 22 is also applies to claim 25.

Claim 25 is clearly being anticipated by Lin ‘369. Therefore, the rejection of claim 25 should be maintained.

**(3) The Rejection Under 35 U.S.C. 103 (a) Yu’883, in view of Lin ‘441:**

With respect to claim 21, the Appellant argues:

*The method* of Yu is unable to etch a deep via hole having substantially the same diameter throughout the depth of the via.

However, claim 21 does *not recite a method* but rather a device includes: a via being formed in a polymer layer having an aspect ratio (defined as depth/width ratio) of which is greater than 1 and is of substantially the same diameter throughout the depth of the via hole.

The product-by-process has been discussed above and also applies here.

Yu, Fig. 3, clearly teaches a via hole 25, being formed in a polymer layer 16 and having at least one vertical sidewall with substantially the same diameter throughout the depth of the via hole 25. Yu, however, does not explicitly disclosing the aspect ratio of the via hole 25, although Yu discloses the polymer layer 16 having a thickness of from 4000 angstroms to 7000 angstroms (0.4  $\mu$ m to 0.7  $\mu$ m, col. 8, line 32-33) and the opening 21 has areal dimension greater than areal dimension of the corresponding first vias 15 (col. 9, lines 14-16).

In view of Lin, a via hole 7 with an aspect ratio of 5, which is greater than 1, can be formed in a polymer layer 5 for forming contacts to a lower layer with smaller resistance and capacitance and is easier and more cost effective to manufacture.

Therefore, the rejection of claim 25 should be maintained.

**(4) The Rejection of claim 21 as an obvious design choice:**

The Appellant argues:

“The Examiner has failed to cite any art which can support his argument”.

However, from Yu and Lin, the obvious design choice is clear. With a particular opening, the aspect ratio (depth/width) can be varied from less than one to greater than one depend on the thickness of the polymer layer.

In view of Lin '441, the thickness of the polymer layer 5 can vary from 2  $\mu\text{m}$  to 30  $\mu\text{m}$ , depend on the electrical design requirements, paragraph [0047], and the opening 7 is in the range of 0.5  $\mu\text{m}$  to 3  $\mu\text{m}$ , paragraph [0050], Lin '441 further adds: "the aspect ratio of opening 7 is designed such that filling of the via with metal can be accomplished" paragraph [0050]. From this teaching, the aspect ratio of the via is clearly an obvious design choice. *In re Rose*, 105 USPQ 237 (CCPA 1955).

Therefore, the rejection of claim 21 for being obvious over Yu '883 in view of Lin '441, with respect to aspect ratio, as an obvious design choice should be maintained.

**(5) The Rejection of claim 21 for not showing criticality or unexpected results:**

The Appellant fails to show the criticality of the claimed aspect ratio nor does any unexpected result have arrived from the claimed ratio. *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Therefore, the rejection of claim 21 for being obvious over Yu '883 in view of Lin '441, with respect to aspect ratio, as non-critical and non-unexpected results should be maintained.

**(6) The Rejection of claim 21 as obvious within the ability of one having ordinary skill in the art:**

The Appellant argues:

"The Examiner fails to cite any art which can support this argument of being general recognized within the level of ordinary skill in the art at the time of invention".

As discussed above, in view of Lin '441, the thickness of the polymer layer 5 can vary from 2  $\mu\text{m}$  to 30  $\mu\text{m}$ , depend on the electrical design requirements, paragraph [0047], and the opening 7 is in the range of 0.5  $\mu\text{m}$  to 3  $\mu\text{m}$ , paragraph [0050], Lin '441 further adds: "the aspect ratio of opening 7 is designed such that filling of the via with metal can be accomplished" paragraph [0050]. From this teaching, through a routine experimentation, the optimum aspect ratio of the via is clearly within the ability of one having ordinary skill in the art, thus it is not inventive for obtaining an aspect ratio of greater than 1. See *In re Aller, Lacey and Hall* (10 USPQ 233-237).

Therefore, the rejection of claim 21 for being obvious over Yu '883 in view of Lin '441, with respect to aspect ratio, as easily obtainable for one having ordinary skill in the art should be maintained.

**(7) The Rejection of Claims Under 35 U.S.C. 103(a) for not showing criticality or unexpected results:**

**(a) Claims 23, 24, 26 and 27**

Lin '369 clearly teaches the via hole, Fig. 10, having a tapered extended into the depth has been formed. The Appellant fails to show the criticality of the claimed tapered sidewall being extended at least one-third of the depth nor does any unexpected result have arrived from the claimed extended depth of the tapered. *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Therefore, the rejection of claims 23, 24, 26 and 27 for being obvious over Lin '369, with respect to the extending depth of the tapered sidewall, as non-critical and non-unexpected results should be maintained.

Furthermore, through a routine experimentation, the optimum extending depth of the tapered sidewall of the via is clearly within the ability of one having ordinary skill in the art. See *In re Aller, Lacey and Hall* (10 USPQ 233-237).

Therefore, the rejection of claims 23, 24, 26 and 27 for being obvious over Lin '369, with respect to the depth of the extending tapered sidewall, as easily obtainable for one having ordinary skill in the art should be maintained.

**(11) Related Proceeding(s) Appendix**

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

/Anh D. Mai/  
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